

REMARKS

Claims 1-44 are pending in this Application, with Claims 1, 7, 15, 22, 25, 28, 32, 36, and 40 being independent. Claims 1 through 3, 5 through 11, 13 through 15, 17, 18, 20 through 40 and 42 through 44 have been amended to improve their form. It is submitted that no new matter has been added by the amendments herein.

Applicant submits that the instant application is in condition for allowance. Favorable consideration and an early Notice of Allowance are requested.

Applicant's undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should be directed to our address listed below.

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE TO SPECIFICATION

The paragraph starting at page 14, line 1 and ending at line 8 has been amended as follows:

--Preferred embodiments of the present invention will now be described in detail in accordance with the accompanying drawings. [This] Each embodiment exemplifies a printhead designed to perform printing by using heat energy [will be exemplified]. Converting a plurality of binary data into multilevel data that can be transmitted over a signal line such as a bus will be referred to as "coding" hereinafter.--

The paragraph starting at page 19, line 18 and ending at line 26 has been amended as follows:

--In this embodiment, the arrangements of printing elements and functional elements for driving them are the same as those in the first embodiment, but the layout of printing elements and block arrangement are designed to drive more printing elements without increasing the number of signal lines. The printhead of this embodiment has 352 printing elements x 2 rows, i.e., a total of 704 printing elements, and can drive the printing elements in the respective rows under different conditions.--

The paragraph starting at page 20, line 7 and ending at line 17 has been amended as follows:

--The printhead includes, for each of two rows, an arrangement comprised of 352 printing elements 1, a driver [block] block 2 for driving the printing elements in one row, AND circuits 3 for determining driving conditions for the respective printing elements, a 3/8 coder 5 for decoding a code for designating a block, a 3-bit latch 4' for holding a 3-bit signal input to the decoder, a 4-bit shift register 4 for sequentially holding input 4-bit data signals, a 44-bit latch 8' for holding printing data for the 44 printing elements in a block, and a 4 x 11-bit shift register 8 for sequentially holding 11 input 4-bit data signals.--

The paragraph starting at page 22, line 6 and ending at line 12 has been amended as follows:

--The second printing control signal[s] generated in the circuit includes BLK outputs B0 to B43. Each output can simultaneously activate eight printing elements. For example, the output B0 controls the printing elements indicated by Seg numbers 1, 3, 5, 7,..., 15, and the output B1 controls the printing elements indicated by Seg numbers 2, 4, 6, 8, ..., 16.--

The paragraph starting at page 22, line 13 and ending at line 25 has been amended as follows:

--By combining the ENB outputs from the 3/8 coder 5 and BLK outputs, which can be arbitrarily selected, in this manner, the 352 x 2 (rows) printing elements connected to the two blocks can be arbitrarily [tuned] turned on/off. By forming a raster image on the printing apparatus side in accordance with this regularity, printing control data can be transferred to the printhead at a high speed. In this embodiment, printing control data for the two printhead rows are continuously input to DATA [3..0] terminals. Note that since block designation data input to the 3/8 coder 5 in this embodiment consists of 3 bits, one bit of DATA 3 is masked. If, however, the number of divided blocks or printing elements increases, this signal can also be used.--

The paragraph starting at page 26, line 22 and ending at page 27, line 3 has been amended as follows:

--Such a circuit arrangement of this embodiment on the semiconductor substrate for the printhead is shown in Fig. 7. The arrangement shown in Fig. 7 differs from the arrangement shown in Fig. 3, in the layout[s] of the 4-bit shift register for receiving the block selection data, in [and] the shift register 8 for receiving the image data, and in the number of printing elements 1. However, the other basic arrangement shown in Fig. 7 is similar to that of Fig. 3.--

The paragraph starting at page 27, line 4 and ending at line 12 has been amended as follows:

--Fig. 8 shows a detailed circuit arrangement in part of the semiconductor substrate for the printhead. Similar to Fig. 7, the arrangement shown in Fig. 8 differs from the arrangement shown in Fig. 4, in the layout[s] of the 4-bit shift register for receiving the block selection data, in [and] the shift register 8 for receiving the image data, and in the number to printing elements 1. However, the other basic arrangement shown in Fig. 8 is similar to that of Fig. 4. And timings of the data transfer are shown in Fig. 9.--

The paragraph starting at page 27, line 13 and ending at line 17 has been amended as follows:

--Note that the positions of circuits for controlling the image data group and the block selection data group are [arbitrary] arbitrarily set within the semiconductor substrate in accordance with the arrangement of the corresponding printhead.--

The paragraph starting at page 32, line 10 and ending at line 17 has been amended as follows:

--According to this embodiment, since the numbers of shift registers 4 and 8 can be decreased with respect to the total number of printing elements, the circuit arrangement can be simplified, and the chip size can be reduced. In this embodiment, the number of control signals (terminals) is three. As in the second embodiment, data is transmitted over a bus, and a further increase in transfer rate can be attained.--

The paragraph starting at page 36, line 12 and ending at line 26 has been amended as follows:

--Although the arrangement of a printing apparatus using the printhead of the present invention will be described later, if an integrated circuit for arbitrating printing control signals is mounted on a carriage on which the printhead is mounted, information for the printhead can be communicated as well as printing control signals. For example, the function of checking a temperature sensor and the like on the printhead can be encoded, and the resultant register value is mapped on the integrated circuit. Alternatively, an image data pattern or grayscale printing data can be encoded and the timing of feedback control for them can be encoded. A circuit on the printhead is preferably [has a circuit arrangement] capable of directly handling these encoded data to directly convert the data into driving control data for printing elements.--

The paragraph starting at page 42, line 10 and ending at line 16 has been amended as follows:

--As described above, since encoded printing control data are sequentially transferred to the printhead of the present invention, these processes can be [speeded] sped up, and the throughput can be improved. Signal lines containing encoded data generated by the raster image control unit 1720 are directly connected to the printhead 1726 via the connection portions 1723 and 1724.--

The paragraph starting at page 45, line 12 and ending at page 46, line 1 has been amended as follows:

--As described above, the scheme of performing printing control on the basis of a communication protocol will greatly influence[s] the forms of future printing apparatuses. More specifically, by encoding printing control signals, the substantial number of connection terminals between the printing apparatus body and the printhead can be reduced, and high-speed data transfer can be implemented. This makes it possible to reduce the communication load and further simplify the arrangement of the apparatus as a direct printer. Since communication protocols that define higher transfer rates have increased in number, the processing speed of a printing apparatus can be effectively increased by using this communication method.--

The paragraph starting at page 52, line 3 and ending at line 13 has been amended as follows:

--Further, the storage medium, such as a floppy disk, a hard disk, an optical disk, a magneto-optical disk, CD-ROM, CD-R, a magnetic tape, a non-volatile type memory card, and ROM can be used for providing the program codes. Furthermore, [besides aforesaid] additional functions according to the above embodiments are realized by executing the program codes which are read by a computer[.]. [t]The present invention includes a case where an OS (operating system) or the like working on the computer performs a part or an entire process[es] in accordance with designations of the program codes and realizes functions according to the above embodiments.--

The paragraph starting at page 52, line 14 and ending at line 22 has been amended as follows:

--Furthermore, the present invention also includes a case where, after the program codes read from the storage medium are written in a function expansion card which is inserted into the computer or in a memory provided in a function expansion unit which is connected to the computer, a CPU or the like contained in the function expansion card or function expansion unit

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performs a part or entire process in accordance with designations of the program codes and realizes functions of the above embodiments.--

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VERSION WITH MARKINGS TO SHOW CHANGES MADE TO CLAIMS

1. A printhead comprising:

a plurality of printing elements for printing;

a block selection circuit [for] that [outputting] outputs a selection signal for selecting a block [of] comprising a plurality of printing elements [that can] to be simultaneously driven;

a printing control circuit [for outputting] which outputs a driving signal for selectively driving said printing elements, together with the selection signal, to each of said printing elements in correspondence with image data; and

an input [means for receiving] portion, which receives external image data to be input to said printing control circuit,

wherein said input [means] portion is adapted to receive the image data and block selection data input to said block selection circuit in a bus format of a plurality of consecutive bits.

2. The printhead according to claim 1, wherein said input [means] portion is adapted to parallelly receive the image data over a plurality of signal lines.

3. The printhead according to claim 1, wherein said input [means] portion is adapted to receive data in units of 4 bits.

5. The printhead according to claim 1, wherein each of said printing [element] elements performs printing [by] using heat energy.

6. The printhead according to claim 1, wherein each of said printing [element] elements performs printing by discharging ink.

7. A printhead comprising:

a plurality of printing elements for printing;
a block selection circuit [for] that [outputting] outputs a selection signal for selecting a block [of] comprising a plurality of printing elements [that can] to be simultaneously driven;

a printing control circuit [for outputting] which outputs a driving signal for selectively driving said printing elements, together with the selection signal, to each of said printing elements in correspondence with image data; and

an input [means for receiving] portion, which receives external image data to be input to said printing control circuit,

wherein said input [means] portion is adapted to receive the image data in a bus format of a plurality of bits.

8. The printhead according to claim 7, wherein said input [means] portion is adapted to parallelly receive the image data over a plurality of signal lines.

9. The printhead according to claim 7, wherein said input [means] portion is adapted to receive data in units of 4 bits.

10. The printhead according to claim 7, wherein said input [means] portion is adapted to receive data to be input to said block selection circuit together with the image data.

11. The printhead according to claim 7, wherein said input [means] portion is adapted to continuously receive the image data and data to be input to said block selection circuit.

13. The printhead according to claim 7, wherein each of said printing [element] elements performs printing [by] using heat energy.

14. The printhead according to claim 7, wherein each of said printing [element] elements performs printing by discharging ink.

15. A printhead comprising:

a plurality of printing elements for printing;

a block selection circuit [for] that [outputting] outputs a selection signal for selecting a block [of] comprising a plurality of printing elements [that can] to be simultaneously driven;

a printing control circuit [for outputting] which outputs a driving signal for selectively driving said printing elements, together with the selection signal, to each of said printing elements in correspondence with image data; and

an input [means for receiving] portion, which receives external image data to be input to said printing control circuit,

wherein said input [means] portion is adapted to continuously receive the image data and data associated with a printing element driving timing [continuously with the image data].

17. The printhead according to claim 15, wherein said input [means] portion is adapted to receive data to be input to said block selection circuit together with the image data.

18. The printhead according to claim 15, wherein said input [means] portion is adapted to continuously receive the image data and data to be input to said block selection circuit.

20. The printhead according to claim 15, wherein each of said printing [element] elements performs printing [by] using heat energy.

21. The printhead according to claim [1] 15, wherein each of said printing [element] elements performs printing by discharging ink.

22. A method of driving a printhead including a plurality of printing elements for printing, a block selection circuit for outputting a selection signal for selecting a block of a plurality of printing elements [that can] to be simultaneously driven, a printing control circuit for outputting a driving signal for selectively driving the printing elements, together with the selection signal, to each of the printing elements in correspondence with image data, and input

means for receiving external image data to be input to the printing control circuit, said method comprising the steps of:

causing the input means to receive the external image data and block selection data input to the block selection circuit in a bus format of a plurality of consecutive bits[,]; and
causing [said] the printing control circuit to drive the printing elements of [a] the block selected by the block selection circuit in correspondence with the image data.

23. The method according to claim 22, wherein said receiving step comprises [the input means] parallelly [receives] receiving the image data over a plurality of signal lines.

24. The method according to claim 22, wherein said receiving step comprises [the input means receives] receiving data in units of 4 bits.

25. A method of driving a printhead including a plurality of printing elements for printing, a block selection circuit for outputting a selection signal for selecting a block of a plurality of printing elements [that can] to be simultaneously driven, a printing control circuit for outputting a driving signal for selectively driving the printing elements, together with the selection signal, to each of the printing elements in correspondence with image data, and input means for receiving external image data to be input to the printing control circuit, said method comprising the steps of:

causing the input means to receive the external image data in a bus format of a plurality of bits[,]; and

causing [said] the printing control circuit to drive the printing [element] elements of [a] the block selected by [said] the block selection circuit in correspondence with the image data.

26. The method according to claim 25, wherein said receiving step comprises [the input means] parallelly [receives] receiving the image data over a plurality of signal lines.

27. The method according to claim 25, wherein said receiving step comprises [the input means receives] receiving data in units of 4 bits.

28. A method of driving a printhead including a plurality of printing elements for printing, a block selection circuit for outputting a selection signal for selecting a block of a plurality of printing elements [that can] to be simultaneously driven, a printing control circuit for outputting a driving signal for selectively driving the printing elements, together with the selection signal, to each of the printing elements in correspondence with image data, and input means for receiving external image data to be input to the printing control circuit, said method comprising the steps of:

causing the input means to receive data associated with a printing element driving timing continuously with the image data[,]; and

causing the printing control circuit to drive the printing elements of [a] the block selected by the block selection circuit in correspondence with the image data.

29. The method according to claim 28, [wherein] further comprising setting a printing element driving time [is set] in accordance with the data associated with the driving timing.

30. The method according to claim 28, wherein said receiving step comprises [the input means receives] receiving data input to the block selection circuit together with the image data.

31. The method according to claim 28, wherein said receiving step comprises [the input means] continuously receiving [receives] the image data and data to be input to the block selection circuit.

32. A data output apparatus for outputting image data and a block selection signal to an input portion [means] of a printhead, [said] the printhead including (i) a plurality of printing elements for printing, (ii) a block selection circuit for outputting the selection signal for selecting a block of a plurality of printing elements [that can] to be simultaneously driven, (iii) a printing control circuit for outputting a driving signal for selectively driving [said] the printing elements together with the selection signal to each of [said] the printing elements in correspondence with the image data, and [said] (iv) the input portion, [means for receiving] which receives external image data to be input to [said] the printing control circuit, said apparatus comprising:

[wherein said data] an output [apparatus] unit that outputs the image data and [the] block selection data input to [said] the block selection circuit in a bus format of a plurality of consecutive bits.

33. The apparatus according to claim 32, wherein the image data is parallelly output to [said] the input [means] portion over a plurality of signal lines.

34. The apparatus according to claim 32, wherein data is output to [said] the input [means] portion in units of 4 bits.

35. The apparatus according to claim 32, wherein [said] each of the printing [element] elements performs printing by discharging ink [with] using heat energy.

36. A data output apparatus for outputting image data to an input portion [means] of a printhead, [said] the printhead including (i) a plurality of printing elements for printing, (ii) a block selection circuit for outputting a selection signal for selecting a block of a plurality of printing elements [that can] to be simultaneously driven, (iii) a printing control circuit for outputting a driving signal for selectively driving [said] the printing elements in the block, the printing control circuit adapted to output the driving signal together with the selection signal to each of [said] the printing elements in correspondence with the image data, and [said] (iv) the input portion [means for receiving], which receives external image data to be input to [said] the printing control circuit, said apparatus comprising:

[wherein said data] an output [apparatus] unit that outputs the image data in a bus format of a plurality of bits.

37. The apparatus according to claim 36, wherein said apparatus is adapted to output, to the input portion, the image data together with data supplied to [said] the block selection circuit [to said input means].

38. The apparatus according to claim 36, wherein said apparatus is adapted to continuously output, to the input portion, the image data and data supplied to [said] the block selection circuit [to said input means, continuously].

39. The apparatus according to claim 36, wherein [said] each of the printing [element] elements performs printing by discharging ink [with] using heat energy.

40. A data output apparatus for outputting image data to an input portion [means] of a printhead, [said] the printhead including (i) a plurality of printing elements for printing, (ii) a block selection circuit for outputting the selection signal for selecting a block of a plurality of printing elements [that can] to be simultaneously driven, (iii) a printing control circuit for outputting a driving signal for selectively driving [said] the printing elements in the block, the printing control circuit adapted to output the driving signal together with the selection signal to each of [said] the printing elements in correspondence with the image data, and [said] (iv) the input portion [means for receiving], which receives external image data to be input to [said] the printing control circuit,

wherein said data output apparatus continuously outputs the image data and data associated with a printing element driving timing [continuously with the image data].

42. The apparatus according to claim 40, wherein data supplied to [said] the block selection circuit is output to [said] the input [means] portion, together with the image data.

43. The apparatus according to claim 40, wherein the image data and data supplied to the block selection circuit are continuously output to [said] the input portion [means].

44. The apparatus according to claim 40, wherein [said] each of the printing [element] elements performs printing by discharging ink [with] using heat energy.

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VERSION WITH MARKINGS TO SHOW CHANGES MADE TO ABSTRACT

[A] The disclosed printhead [is disclosed, which] can speed up transfer of image data and driving of printing elements without increasing the number of signal lines and connection terminals. An image data signal supplied to the printhead has a 4-bit bus format containing block selection data in its head. This signal is separated by a selection signal, and only the block selection data contained in the head is held in a latch and supplied to a decoder. The 4-bit image data corresponding to the four subsequent segments are respectively held in the four latches of a first printing control unit.

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